Work, Energy and Power – Practice

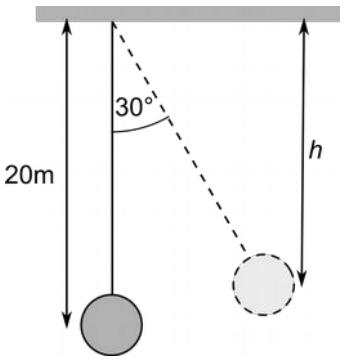
1. Calculate the time taken by a water pump with output, with power 500 W to lift 2000 kg of water to a tank, which is at a height of 15 m from the ground. *(588s)*

2. A cyclist is cycling at steady speed of 5.0 m/s and developing an average power of 300 W. Calculate the total resistive force. *(60 N)*

3. An electric motor has a supply of 12V and draws a current of 1.5A.
   The motor lifts a 2.0 kg mass a height of 1.0 m in 2.5s.
   Calculate the efficiency of the motor. *(Electrical power, P = V x I) (0.44)*

4. Two people push a car of mass 1000 kg, one at each rear corner.
   Each exerts a force of 120 N at an angle of 20° to the direction of motion.
   (a) Calculate the work done by the two people in pushing the car 30 m *(6.7 kJ)*
   (b) The resistance to motion is 100 N.
   Calculate the speed of the car, if it starts from rest. *(2.7 m/s)*

5. On a demolition site there is a heavy steel demolition ball, mass 500 kg, on a chain, length 20 m to the centre of mass. It is pulled aside to an angle of 30°.



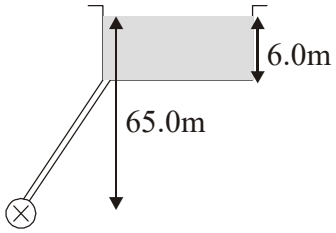
   (a) Calculate:
   (i) the vertical height, *h*, of the support above the centre of the ball, *(17.3 m)*
   (ii) the increase in gravitational potential energy of the ball. *(1.3×10^4 J)*

   (b) The ball is released and hits a wall when the chain is vertical.
   Calculate the speed of impact. *(7.2 m/s)*

6. 5×10^5kg of water flows over a 60m high waterfall every second.
   30% of the energy of the falling water can be turned into electricity.
   Calculate the power available. *(8.8×10^7 W)*

7. A train of mass 5×10^5 kg is travelling at a speed of 30 m/s up a slope of 1 in 100.
   The frictional resistance is 50 N per tonne.
   Calculate the output power of the engine. *(2.2MW)*

8. Water in a reservoir with vertical sides has a surface area of $2.0\times10^5\,m^2$ and is 6.0m deep. Its surface is 65.0m vertically above a hydroelectric turbine/generator. density of water = $1000kgm^{-3}$.
Calculate:



(a) the average height of the water above the turbine,

(b) the volume of water in the reservoir, *($1.2\times10^6\,m^3$)*

(c) the mass of water in the reservoir, *($1.2\times10^9\,kg$)*

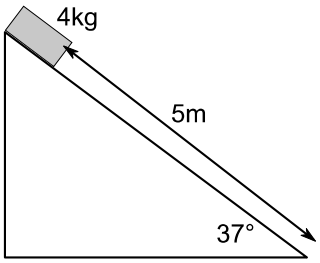
(d) the maximum potential energy available from the water. *($7.3\times10^{11}\,J$)*

9. A car, mass 1000 kg, is traveling at 20 m/s.
The brakes can give a force of 3500 N. Calculate:
   (a) the kinetic energy of the car just before it brakes, *(200 kJ)*
   (b) the distance the car travels during braking to a stop, *(57 m)*
   (c) the time it takes the car to stop. *(5.7 s)*

10 A piano, mass 250kg, is lifted using a diesel engine from the ground to a window 9.0 m above the ground. The output power of the engine is 700 W.
Calculate:
   (a) the time taken to raise the piano to the window. *(31.5 s)*
   (b) the amount of chemical energy converted by the engine, if its efficiency is 18%. *($1.2\times10^5\,J$)*

11. A car of mass 1000 kg, travelling at 12m/s up a slope inclined at 15° above the horizontal, stops in a distance of 25 m.
Calculate the frictional force which must be acting. *(344N)*

12. A box, mass 4.0 kg, slides from rest a distance of 5.0m down a ramp at an angle of 37°, as shown.
Assume that the frictional force is constant.
At the bottom of the ramp it is moving at 7.0m/s.



Calculate:
   (a) the weight of the box; *(39 N)*
   (b) the potential energy lost by the box; *(118 J)*
   (c) the kinetic energy gained by the box; *(98 J)*
   (d) the work done against friction; *(20 J)*
   (e) the size of the frictional force. *(4.0 N)*